CHANGING WORLD TECHNOLOGIES, INC.

Response to Biofuels Task Force – January 2008

COMMONWEALTH OF MASSACHUSETTS

Governor Deval L. Patrick

Massachusetts Executive Office of Energy & Environmental Affairs

100 Cambridge Street
Suite 900
Boston, MA 02114
Attn: Steven Clarke

MASSACHUSETTS ADVANCED BIOFUELS TASK FORCE

Submitted by: Changing World Technologies, Inc. www.changingworldtech.com

The following document is submitted in support of the request of the Massachusetts Advanced Biofuels Task Force, to provide suggestions to affect change and to better understand an alternative energy technology which can assist in meeting the Governor's stated goals and objectives.

Any actions or changes should look to leverage existing federal incentives and programs available for other alternative energy technologies, and help remove the barriers to achieve low cost renewable energy. It is particularly important that federal and state alternative energy policies work in tandem and not at cross purposes. For example, recent energy tax legislation passed by the Congress, but not signed into law, makes stationary source fuel, including home heating oil, ineligible for the $1.00 per gallon renewable diesel tax credit. This is occurring at the same time that Governor Patrick has proposed requiring home heating oil to have a renewable component. Unless Congress continues the eligibility to allow home heating oil the $1.00 renewable diesel credit (eligible now), it will be more difficult and expensive to achieve the Governor's renewable energy goals for home heating oil. This is precisely the type of federal-state policy coordination that is required to reach the Governor's renewable energy objectives.

The plan to displace fossil fuels can be achieved, if the Commonwealth and other states move to provide parity for alternative energy producers with that of traditional petroleum industries' myriad of direct, indirect, and often camouflaged subsidies, and the specifically designed agricultural subsidies that do well in promoting food crops. The fastest way to do this is to create a comprehensive enabling package which includes tax reform, changes to existing programs, and the recognition of the leverage opportunities against federal government programs. Done right, this package will be attractive to the capital markets and industry, and create certainty for investing in renewable energy. These actions

cannot be mere teasers, but must serve as an alternative energy roadmap, which takes us to a positive transformation, and into alternative energy.

The Package

An Enabling Package will:

- Stimulate manageable investments
- Reduce price and technology risk
- Establish financial certainty
- Catalyze new-tech entrepreneurs
- Avoid tax shelter abuse

Specific changes needed include, but are not limited to:

1. Integrated Tax Policy Changes
   - Provide for refundable excise tax credit to producer facility for a minimum of 15 years:
     - Provide a $1.00/gallon excise tax refundable credit to the producers of renewable liquid fuels derived from biomass and solid waste streams at an eligible production facility, employing new renewable technology;
     - Maintain the eligibility of stationary source fuel, including home heating oil, produced from biomass for the $1.00 per gallon federal renewable diesel tax credit.

2. Allow for long-term contracting authority for all agencies similar to the U.S. Defense Department authority under 10 U.S.C. § 2922a:
   - Government agencies should be authorized to commit to long term purchase contracts with new-tech renewable fuels producers;
   - The duration of these contracts should coincide with the period over which plant project finance debt is repaid by the producer-typically 15-25 years;
   - This commitment will provide the security necessary to induce participation from the private sector necessary to finance construction of "eligible" production facilities;
   - Agency budgeting protocols must be modified to assure that annual contract outlays to acquire new-tech renewable fuels are reflected in the future periods when actually made - not in the aggregate in the initial period when the future commitment is made.

3. Expand Renewable Fuel Standard (RFS) eligibility for fixed energy fuels:
   - New-tech renewable fuels should be counted towards meeting compliance obligations under the "RFS" or other renewable use requirements, whether consumed as transportation, stationary engine, or boiler fuels;
   - Serious consideration should be given to allocating a portion of such renewable compliance obligations exclusively to new-tech renewables in

future years, to promote interest in emerging technology by the public and private sectors, as well as academia.

4. Expand Loan Guarantees or Tax Subsidized Financing:
   - The current renewable electricity "tax credit in lieu of interest" CREBS bond authority should be extended to financing of "eligible facilities" producing new-tech renewable liquid fuels; [IRC Sec 54]
   - The current $1.2 billion cap on the authorized amount of these "Green Bonds" should be increased to at least $25 billion to accommodate growth in renewable electricity facility investment, and the new application of this financing device to renewable liquid fuels.
   - The current $1.2 billion cap also needs to be increased to create a market for these "Green Bonds." Creation of a trading market (LIQUIDITY) will reduce the implicit interest rate of these bonds borne by the taxpayers, and encourage more private sector interest in financing new projects.

5. Extend renewable electricity credits:
   - To include Btu equivalent for industrial boilers that produce steam and other heat energy.

6. Master Limited Partnership Eligible:
   - Amend tax code to allow owner-entities of "renewable electricity" generation property or "renewable fuel producers" to enjoy a "unified" single-tier income tax, which follow petroleum pipeline/terminal Master Limited Partnership ("MLP") provisions and commercial real estate REIT structures.

7. Provide feedstock and technology-neutral definitions for renewable fuel eligibility:
   - "Renewable diesel" means: Combustible organic liquids other than biodiesel, for use as fuels or blendstocks, manufactured by thermochemical processes other than refinery co-processing that substantially alter the chemical composition of waste biomass.

The Will to Lead

Many initiatives and programs are being considered to stimulate alternative energy usages, due in part to rising energy prices and the pressure they put on our economy. Massachusetts has an opportunity to stabilize disruptive energy price in the markets. The timing is right for the Commonwealth's leadership to encourage the development of new technologies, which can tap into the enormous renewable resources available for processing. Massachusetts clearly has the will and now a new way to affect change, and at the same time eliminate a burdensome liability, waste.

The Alternative Energy Dilemma

The dilemma is how the nation moves to a more sustainable existence. The expanded

use of corn starches, plant sugars and vegetable oils cannot be expected to meet the demand for increased reliance on renewable fuels, without placing severe upward pressure on food prices. In addition, many states no longer have the agricultural resources to convert crops into fuels. Talks of refineries supplementing their supplies are also unrealistic. The fundamental business model for processing alternative feedstock and using existing oil refineries falls short due to limited volumes, difficult logistical hurdles in aggregating feedstock, and competition with established markets for high value products, including oleo chemical and food crops. The Commonwealth, states, and Congress need to broaden their views in support of renewable energy. They need to include other available technologies and feedstock opportunities, if we are to significantly displace petroleum-based fuels. Waste streams constitute a largely untapped potential source of renewable energy, and offer one such possibility. Waste streams that displace petroleum also provide significant environmental benefits. The U.S. generates approximately 7.1 billion tons of economically recoverable agricultural, industrial, municipal, and animal waste annually. The fuel produced from this waste could displace up to 25% of the U.S.'s total petroleum demand of 23 million barrels per day. Each ton of processed waste can displace up to one barrel of petroleum.

The CO_2 Concern

Ninety percent of the world's energy is derived from fossil fuels. Currently, no price is placed on spewing carbon dioxide into the atmosphere. An assessment by the United Nations Inter-governmental Panel on Climate Change cites with more than 90% certainty, human use of fossil fuels as the main cause of climate change. Global warming is a potential threat, but its effects remain locked in debate. To move towards a more sustainable environment, technological transformation must be funded. The markets need clear, consistent and transparent pricing mechanisms to stimulate change. Special interests have influenced carbon trading markets in Europe, underscoring the need for a different mechanism in the USA. Done right, it should result in an equitable distribution of payments and charges based on the amount of CO_2 released into the atmosphere, due to each energy source's total lifecycle.

The Nation's goal of reducing carbon dioxide emissions can be achieved through a fundamental shift away from the consumption of fossil fuels. Renewable liquid fuels displace traditional fossil-based fuels while reducing CO_2. The Commonwealth, states, and Congress are at a crucial juncture where they must determine how to implement a plan that achieves both of these goals. There are serious question regarding the CO_2 benefit of these new fuels. The input energy required to produce liquid fuels has a CO_2 effect, together with the CO_2 released during consumption. The carbon footprint of any liquid fuel can and should be determined before we begin to mandate their uses.

Renewable energy companies rely on revenues derived from carbon credits. Volatility in these markets drive away the capital markets and delay the technological transformation required to slow global warming. A Cap and Trade approach simply does not work, and is now further questionable, due to the current European Union failures.

The following highlights key differences in the two approaches:

- A Tax on Carbon [would work]
  - Tax each ton of CO_2 emitted into the air
  - Sends a clear price signal to the market
  - This is less susceptible to political tampering and market manipulation
  - Can be used as revenue raiser to offset other taxes
  - Simple monitoring and reporting structures
  - Needs to be big to create the incentive to find solutions

- A Cap and Trade Regulatory System [does not work]
  - Lets polluters trade permits to emit CO_2
  - Political advantage - hope to deflect anger over higher costs
  - Permits are the equivalent of cash, creating fraud opportunities
  - Long delay in implementing the structural complexities
  - Difficulty for regulatory enforcement (Audit)
  - Certification done by third party. Issues of liability and how to ensure legitimate credits in a global economy

Note: CO_2 is a pervasive by-product of the economy and long lived in the environment. It cannot be compared to the SO_x trading schemes. It is one opportunity that will take the political will to do, but would be an added benefit to encourage change.

The Added Benefit of Turning Waste-to-Oil

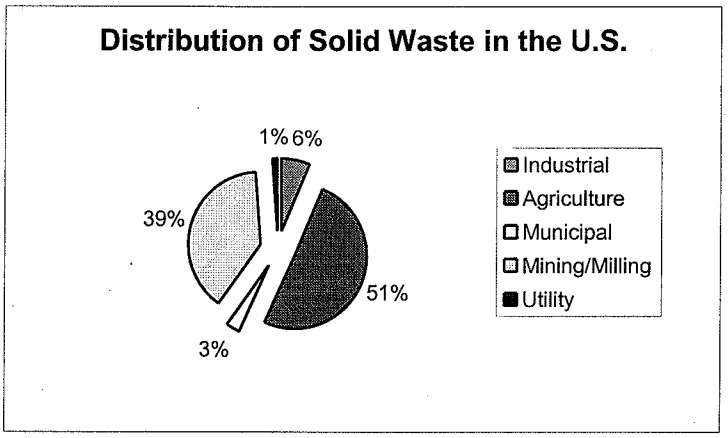
A significant advantage of utilizing waste is that no new carbon needs to be extracted from beneath the ground, making waste *CO_2-neutral*. In addition, there is a significant advantage to the Life Cycle Analysis (LCA) when using waste (see LCA references). In the past, dependence on oil has cost our economy dearly. With our growing reliance on imported oil, future price shocks are expected to be costly to the economy. Ultimately, the solution to the oil dependence problem lies in new technological developments, which help remove our reliance on these imports. Technologies that can use local resources to produce fuels and utilize existing infrastructure will facilitate an even quicker change to reducing our dependence.

There have been considerable research efforts directed at finding new technologies to address our energy needs. The majority of these efforts would most certainly require large amounts of capital and a change in the existing energy infrastructure, or changes to environmental regulations. Numerous technologies have attempted to address the often-conflicting objectives of energy and environmental advocates; but have failed to produce, on a timely and self-sustaining basis, a cost effective solution. The Thermal Conversion Process (TCP) addresses these conflicts, and
complements existing infrastructures that have been established over the years by the petroleum and energy industries.

Changing World Technologies, Inc. (CWT) has developed a technology that turns waste into a renewable fuel oil and other products. CWT's Thermal Conversion Process or (TCP) breaks down waste materials by using heat and pressure to produce oil and other co-products. This technology not only produces clean-burning renewable oil, but promises to reduce the use of landfills and reduce our dependence on foreign sources of fossil energy. An investment of approximately $125 million was made over 10 years from concept to commercialization. The first full-scale plant, which uses the Thermal Conversion Process, was built at a Butterball Turkey processing facility in Carthage, Missouri, and initiated operations in the summer of 2004.

In the United States, approximately twelve billion tons of solid wastes are produced each year. (*See **Figure 1***)

Figure 1



GAS RESEARCH INSTITUTE and AMERICAN GAS ASSOCIATION,

Solid Waste Management, June 1996

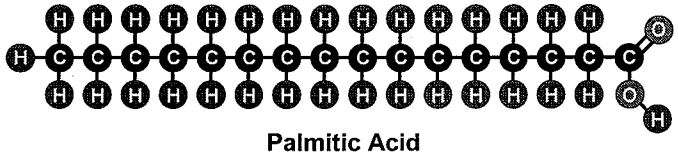
In the U.S., agricultural waste residues are estimated by the EPA to be in excess of six billion tons each year. Municipal waste represents 3% of the solid waste, while the tire industry discards approximately 270 million tires annually. These represent significant future feedstock potential for the TCP. In addition, three billion scrap tires have been stockpiled throughout the United States, and may also be available to process. Mixed plastics, including post consumer electronics, and auto shredder residue (the residual material after autos are shredded), have also demonstrated to be effective feedstock for TCP. Approximately three to five million tons per year of this material (primarily rubber and plastics) are currently going into landfill.

Municipal and regional sewer authorities are requiring industries to reduce their organic biological oxygen demand (BOD) and chemical oxygen demand (COD), and solids loading to the sewers. There is a great need for cost-effective and application-specific treatment technologies to manage wastewaters and solid wastes effectively. With the recent changes to animal feeding practices related to fats and greases, there has been an increasing problem related to trap grease systems. This material wrecks havoc on sewage treatment processes. With the successful utilization of trap greases in the TCP, these process problems

can be avoided and these waste seen as an alternative energy feedstock. Furthermore, Health and Environmental Agencies could then enforce restaurant regulations related to disposal of cooking oil, further alleviating the growing problem caused by illegal dumping down the drain.

Chemistry of TCP

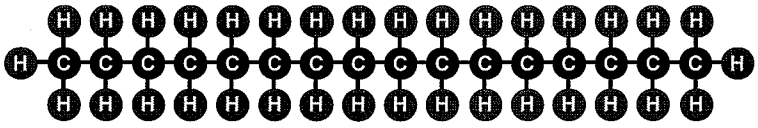
The utilization of waste as a source of alternative fuels is within our reach. The chemistry is obvious and sound. There are many theories to explain the formation of crude oils, which we use to make plastics, rubber and other potential feedstock for the TCP. One widely accepted theory of how oil is formed suggests the subduction and cooking of plants and animals within the earth over thousands of years. Whatever theory we accept, the structures of plants and animals (organic material) are similar to the structure of crude oil, making it obvious that we can supply the world with bio-based products, including power and transportation fuels, from waste. A simplified explanation of the chemistry is illustrated below, using just one component that is common to plants and animals, fatty acids. Animal fat consists of triglycerides, molecules composed of a glycerol backbone with three attached fatty acids. One typical fatty acid is Palmitic acid:



Palmitic Acid

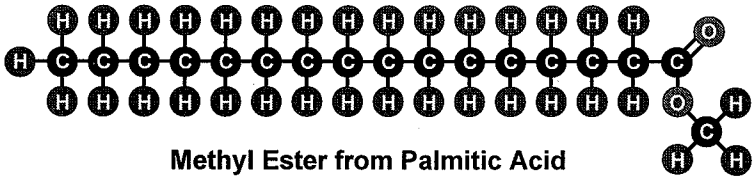
The Palmitic acid molecule consists of a long chain of carbon atoms with attached hydrogen atoms. At one end is a group consisting of one carbon, two oxygen, and one hydrogen. This is called the "carboxyl" group [-COOH], which gives the molecule its acidic character. Palmitic acid contains sixteen carbon atoms, so it is designated a C16 fatty acid. Triglyceride fats consist of three fatty acids that are similar to Palmitic acid, although some have more carbon atoms than Palmitic acid.

Setting aside the carboxyl group, the Palmitic acid molecular structure looks like a hydrocarbon molecule with sixteen carbon atoms. Petroleum fuels (fossil fuels) are mixtures of long and short-chain hydrocarbons. Cetane is often used as a characteristic molecule of the mid-range of diesel fuels. Its molecular structure is:



Cetane

This is not the same biodiesel that is being promoted by the rendering industry. There are biodiesel fuels that can be made from fatty acids by substituting a [-CH_3] group for the hydrogen atom [-H] in the carboxyl group on the fatty acid. The simplest fatty ester that could be formed from Palmitic acid is:



Methyl Ester from Palmitic Acid

A disadvantage of converting the fatty acid to an ester aside from costs (biodiesel) is that storage and solubility problems exist. Fuel blenders are often presented with complications in blending biodiesel with their standard fuel oil, which presents logistical issues. In order to overcome the solubility issues for these types of fuels, supporting and funding the construction of new infrastructure necessary to handle these difficult materials, needs to occur. The process to add an ester to a fatty acid is called "transesterfication."

The Massachusetts Factor

It is our belief that the Commonwealth of Massachusetts is in a leadership position to show the nation how to change the way we handle waste and promote a bio-based renewable economy. If fair, well thought-out incentives are provided and parity is established within existing incentives and subsidies, facility construction can begin in Massachusetts more quickly using existing technologies, including the TCP. Upon the deployment of new alternative energy facilities, the following can be achieved:

- Dramatic reduction of waste material going into landfills and incinerators;
- Production of large volumes of renewable diesel fuel oil;
- Elimination of large dioxins source;
- Reduce dependency on foreign oil, providing energy security;
- Use of existing energy infrastructures to ensure energy support;
- Reduction in new greenhouse gases slowing global warming, by encouraging the use of waste material.

We remain hopeful in helping Massachusetts meet its challenges of eliminating waste, providing a clean source of renewable energy, and minimizing global warming.

References:

Hydrothermal Processing in Biorefineries – A Case Study of the Environmental Performance – (*Life Cycle Assessment - Food Processing Waste)*
Morgan Fröling [1,2] Andrew Peterson[2] and Jefferson W Tester [1,2]
[1] Laboratory for Energy and the Environment, Massachusetts Institute of Technology
[2] Department of Chemical Engineering, Massachusetts Institute of Technology
Tel: +1 617 258 6084. Fax: +1 617 253 8013. E-mail mfroling@mit.edu

Vehicle Recycling Partnership Life Cycle Analysis – (*Shredder Residue)*
Candace Wheeler, General Motors
September 29, 2005

Roundtable Trap Greases - (*Assessment on Technology)*
New York City Dept. of Environmental Protection
Nassau County
Suffolk County
Westchester County
August 21, 2007

NYSERDA Trap Grease Evaluation – (*Assessment on Availability*)
September 2006

KeySpan Services, Inc. and Brookhaven National Laboratory Report
(Fuel Quality Study in Stationary Applications)
Stephen M. Eber, P.E. and C.R. Krishna, Tom Butcher, Wai-Lin-Litzke
October 19, 2006

Society for Energy and the Environment - Emissions Test Report
(AP42 Emissions Profile)
June 6, 2007

County of Los Angeles Conversion Technology Evaluation Report
Phase II Assessment – Converting Waste into Renewable Resources
(Alternatives to Landfill and Incineration)
October 2007